EARLY FLASH FLOOD WARNING SYSTEM WITH SAFE ZONE MAPPING

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ABSTRACT

The flash flood is prone to the countries across the world. It is a major threat to developing as weel as developed countries. Recently, Sri Lanka witnessed highest rainfall which was caused by El Nino due to which the people suffered from one of the biggest natural calamity. Many lives were taken away. This is mainly due to the communication failure to alert the people earlier. Chennai flood was also very similar to this one. To ensure that this will not happen in future we propose an intelligent flood monitoring, detecting system with alert notification using IoT. The proposed system would contain three phases: first phase is to collect the data from the sensors which are placed on the dam or any water bodies; next phase will analyze and process the collected data at the server side in order to measure the threshold values; last phase will be the mobile module which forms the basis for communication. The system however do not stops here but it also proceeds to send this alert notification to the popular social networks as it is felt that social networking is at the moment one of the familiar communication paradigm. A safe zone mapping is also done in the mobile module so as to capture the clear cut image of the safer places and its accommodation capacity. Since it is very difficult to know the safer zones at the time of emergencies, this safe zone mapping is done.

Keywords:ATMEGA32

1. INTRODUCTION

Floods are responsible for the loss of precious lives and destruction of large amounts of the property every year, especially in the regions where cyclones are very common. In flash floods, water level rises rapidly leaving a very less chance of alerting the public early. These flash floods are occurring very common in all parts of the world due to the enormous population growth which leads to the deforestation and global warming. Flooding is a natural phenomenon, which cannot be prevented but it can be restricted. Floods could affect the countries like India, Bangladesh, Sri Lanka, Philippines and poor and uncivilized countries where communication and evaluation is a challenging task[1].

Figure 1.Sri Lanka Floods 2017

Currently, there is no automated system existing in India to monitor, detect and alert the public and government. The main reason for the development of this project is to prevent the huge monetary and lives loss. It is understood that the flood risks will not decrease in the future and with the beginning of climate change, flood intensity and frequency will threaten many regions of the world[2]. To minimize the extent of damages caused by flood, warning systems to inform the people of the disaster should be implemented in high risk areas. This proposed system will be able to reduce the damages of flood.

To effectively monitor and detect occurrence of flood in flood prone areas, monitoring and detecting systems should be deployed to such areas to measure and record the required parameters. What makes a good monitoring system lies in the equipment used in the detection[3]. The tools used in our systems are reliable and cost efficient.

Figure 2. Chennai Floods 2015

IoT is used as a root for collecting the information and data from the water bodies[4]. This IoT may or may not rely on the internet usage. WSN acts as a backbone for this technology. This information is transferred to the server and is processed. If the processed data exceeds the value which is predefined, an automatic alert notification will be given. At the user side, an application is deployed by which the message sent can be viewed. Safe zone mapping is also mapped at the time of warning message. This alert notification can also be published in social networking like Facebook and Twitter.

2. RELATED WORKS

A report byAsraful Islam et al[5] involves the design and implementation of water monitoring system that provides a solution to remotely monitoring water levels, early warning of events with mobile access information. This system consists of the field sensor, Arduino Ethernet shield, data collection software module, mobile based module which is linked to the government authorities. The system presents useful characteristics as large network capacity, sensor hardware compatibility, long-range communication, low-power consumption. Practically, during flash floods the network is at stake. Moreover, the message is sent only to the government authorities. Again, this is in the hands of the government whether to alert people or not.

The purpose of this project was to develop a real-time wireless flood monitoring system by using the concept of ultrasonic waves. This built system can automatically sense the water level and then send this value to the control room through the wireless system to display it on LCD. Then depending on the measurements of the previous year for the same water body, it also have a set of LEDs to show that the current value of the water level located in which area. Abubakr Rahmtalla et-al[6] developed by using ATMEGA32 micro-controller. Here, only a buzzer is activated. There is no alert messages sent. This is not that much efficient in today's technology and is not compatible too. Also, this buzzer is sent to the control room. Again, here also the government should only decide to inform the public or not.

This paper demonstrates the flood monitoring and warning system using SMS. The system provides timely information and alerts at-risk to the populace and relevant authorities by means of SMS when the level of water surpasses the user defined threshold value. GSM module is used for sending the mobile text messages while the Arduino Uno Microprocessor is used to read in the input from the pressure sensor and then calculate the height of the water.

A flood warning system by Sheikh Azid et al[7] is deemed to be one of the fastest and cost effective method of alerting the relevant authorities and the vulnerable residence. One

problem in the system may develop if the network provider makes changes to the network. The GSM module cannot upgrade itself. Moreover, setup uses storage batteries so there is a chance of loss of battery consumption.

Food warning system by Edward et al[8] is especially proposed for the Nigeria. This FMDS based on WSN is to continuously monitor, detect and report the environment's status to a control unit using relative humidity, temperature, water level and amount of rainfall as flood indicators, whose values are gathered by sensors in the sensor field. The FMDS monitors and know the development of floods and then send flood notification SMS to the inhabitant of such zones for necessary actions. The developed FMDS covers 15 flood prone regions in Uyo metropolis in Akwa Ibom State, Nigeria. This system is composed of sensor field module and the phone module. The installment of this is very expensive. The WSN most of the times is not available since the region was too interior and there is no aware of the network connectivity among the people in and around the river basin.

A research paper by Shalini et al[9] proposed the architecture for an early warning floods system to alert public against flood disasters. This project focuses on monitoring water level remotely using wireless sensor network. The project also utilized GSM and SMS to relay data from sensors to computers and then alert the respective victim's through their phone. The project was deemed as a success. But, the project was unable to be integrated between software development and hardware design. Further, the system has several parameters and conditions to process through the successful compilation.

The above discussed systems has its own advantages and disadvantages. The major problem faced by all the people across the world is that there is no proper preventive measures and lack of communication. Dry out situation may occur in the all the above mentioned systems because there is no sufficient storage for the backup restore. The water neither can be used for agriculture and nor for the drinking purpose as it is not compatible to restore it since excess water with backup water have been released out due to the constraints used in the programs. So we proposed a system which can overcome all the disadvantages seen in the above discussions.

3. PROPOSED SYSTEM

Our proposed system aims at developing an alert system that reaches the common people directly. The best way to reach the people directly is via android phones. So our perspective is to develop an android application that alerts people directly about the water level, current geographical weather conditions and provides the emergency alerts so that people can relocate accordingly.

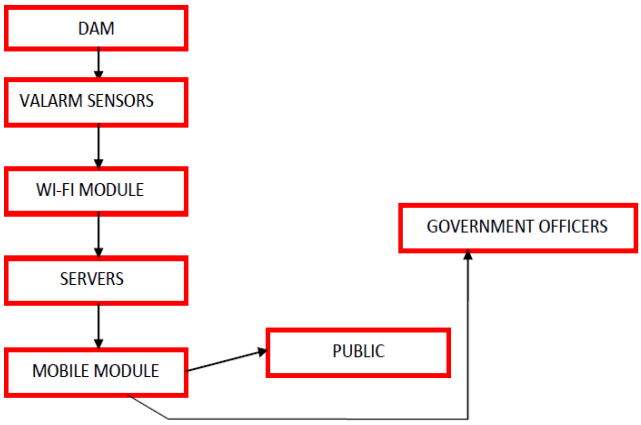

Figure 3. Proposed system architecture

The steps followed to design the proposed system are as follows:

3.1Installing sensors at the dam:

The first and the foremost process is the installing the sensors and deploying it in the dam section. The sensors can be either placed on the top of the pipes or it can be placed on the top surface of the water on the dam if it is water resistant.

3.2 Connectivity:

The next step is to enable the connection between the sensors and servers. This is a very crucial step because from this only, our main process starts since here only the collected data will be transferred to the servers in order to analyze the recorded value with the predefined values. The connectivity module can be a Wi-Fi Module or WSN Module.

3.3 Analyzing the recorded value:

The collected data from the sensors are processed and is analyzed to check or to verify with the threshold values. If the analyzed values are below the threshold values, the system does not do any operation, it just keeps on monitoring; else if the

analyzed values are nearing the threshold values or it is higher than the threshold values, an alarm sound will be given with an automatic notification of messages with necessary details will be delivered to the users and the government authorities located at that particular areas. This information is shared on the social media too. These data are stored on the servers for later and future uses.

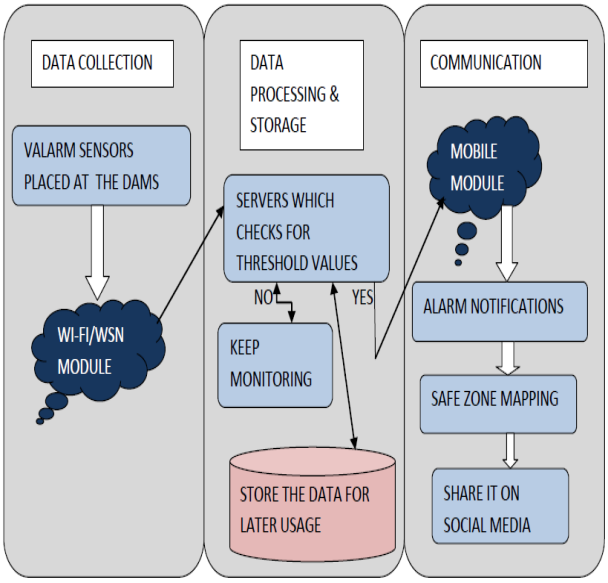

Figure 4. Block Diagram for the proposed system

From the above diagram, a clear view of the proposed system is shown. At first, the sensors at the dam side collects the data and pass it on to the servers through Wi-Fi module. The servers in turn checks the collected in order to check whether the recorded values reached or exceeded the threshold values or not. If exceeded, then the mobile module will be activated. In mobile module, an alarm notification is send to both the government authorities and public so as to inform about the emergency situation. Safe zone mapping is done in prior to ensure the safeties for rehabilitation. These alert notifications can also be shared on social media. The processed data and shared data are stored in the database. This can be helpful for future analysis. At the server side the activities of the sensors and other relevant details are recorded on the websites. This will ease the access for the researchers. A sample webpage is shown below. In extreme flood condition the website will tend to trigger the server to give an alert notification with alarm sound so as to warn the public to be ready for the evacuation. The idea is that the sensors connect with server and requests the insertion of new data. Then the server authenticates the request and decides whether or not to allow the aggregation to the database. The data-pool hold the records of location and geographical details of the dam and residents phone number are stored in contact which is connected along with their emails. The danger level and warning level information of dam or any water bodies are collected from the Flood Disaster Management Sector, India water development board[10].

Figure 5. A sample main page of our flood monitoring website

4.MODULES OF THE PROPOSED SYSTEM

Modules used in our proposed work are as follows:

4.1 Valarm Sensors

In this proposed system, we have used valarm sensors. It helps to monitor, record and track the water level. It is a customized IoT sensor which can be used for:

- Remotely monitoring industrial equipment on fleet vehicles
- Flood monitoring, Remote environments, Temperatures
- E-mail alerting

4.2 WSN/WI-FI Module

IoT requires huge scalability in the network space to handle the surge of devices. With billions of devices being added to the internet space, network layer scalability plays a major role. In the proposed system we took IEEE 802.11. There are several Wi-Fi modules are available to built the IoT. In this proposed work we had used WHIZFI WHZ5178 Wi-Fi module which is a full-featured Wi-Fi module that includes support for high linear output power and IEEE 802.11 security. The module provides SDIO/SPI interface to communicate with a variety of

host devices. Module supports client and SoftAp mode with platform independent.

5. SYSTEM IMPLEMENTATION

Table 1.Pseudo code for the first phase

1	Start
2	Record the contact numbers of the residents who are in the flood prone areas
3	Make sure that the app is installed on the phones
4	Sent alert message with safe zone mapping
5	Check for clearance
6	Notify the users
7	Stop

1	Start
2	Read from sensors
3 4	**If**(value<threshold) **Then** Measure and record
5 6 7	**Else if** (value>threshold) **Then** Record and sent alarm signal to the server Give alert notification message to the public and to the govt.
8	Post the alert message on social network
9	Stop

Table 2. *Pseudo code for the second phase*

6. RESULTS AND DISCUSSIONS

Several tests have been conducted to verify the correctness of our project. The tests were conducted to accomplish the objective of the project that the system able to record all the values and is able to give an alert messages or not. The main objective we have gained from the system is able to spread the news quickly during the calamity which is made possible by integrating the social media with our application.

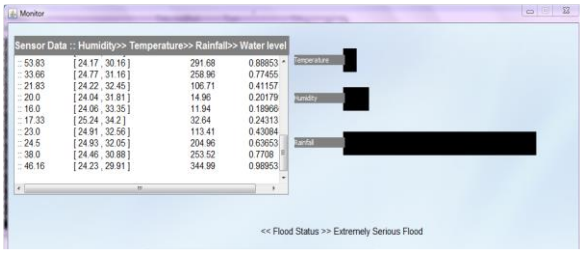

Figure 6. Flood Monitoring GUI

7. CONCLUSION

Flash flood monitoring requires a dense network to ensure the accuracy of collected data. Those data have to be interpreted by means of empirical and formal models by correlating in real time data. Large scale deployment of a sensor based system is a challenging tasks specifically when we are targeting an eminent natural disaster. The proposed have overcome from this problem by utilizing the IoT. Finally, the proposed system is fast, cheaper and reliable hence it helps prevent the loss of lives, damage to the properties.

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